

Application No.: 09/914,356  
Response under 37 CFR 1.111  
Reply to Office Action dated June 25, 2003  
September 25, 2003



REMARKS

Claims 1-18 are currently pending in the application.

Claims 1-18 were rejected under 35 USC 102(a) as being anticipated by PCT Publication No. WO98/16680 (the publication). This publication is the international priority application of U.S. Patent No. 6,156,075.

The Examiner believed that this publication teaches a metal chelate forming fiber in which reactive functional groups are grafted onto a natural fiber or regenerated fiber. The Examiner also believed that the publication teaches the grafting compound contains a glycidyl group in its molecule and the metal chelate forming compound is of the type contemplated by applicants such as ethylenediaminodiacetic acid (see column 4).

This rejection is respectfully traversed in view of the following remarks.

The present invention relates to a novel metal chelate-forming fiber, a process for producing the metal chelate-forming fiber, a method of capturing metal ions with the use of the fiber and a metal chelate-fiber.

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The subject matter of the present invention is that at least one metal chelate-forming compound selected from the group consisting of aminodicarboxylic acids, thiocarboxylic acid and phosphoric acid which are reactive to epoxy group is bonded to a fiber molecule of a natural fiber or regenerated fiber through a crosslinkable compound which has a reactive double bond and a glycidyl group in its molecule.

The metal chelate-forming fiber of the invention comprises a natural or regenerated fiber as a base fiber and is highly wettable with, for example, an aqueous liquid.

The fiber molecule allows the crosslinkable compound to be easily introduced into the fiber molecule by reacting the crosslinkable compound having a double bond and a glycidyl group in its molecule in the presence of a redox catalyst. After the introduction of the crosslinkable compound, the fiber molecule is subjected to reacting with a metal chelate forming compound which is reactive with a glycidyl group to thereby easily impart chelating capability to the fiber molecule.

The process of the present invention produces a metal chelate-forming fiber that can efficiently and easily introduce a metal chelate-forming compound into a molecule of a natural or

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regenerated fiber through a crosslinkable compound. As the process of the invention, a process is employed in which the crosslinkable compound is subjected to graft-reaction with the fiber molecule using a redox catalyst and the resulting reaction product is subjected to an addition reaction with the chelate-forming compound.

As a concrete process for enhancing the efficiency of the graft reaction to the molecule of the natural or regenerated fiber, it is preferable to treat the fiber with a divalent iron salt previously and then apply hydrogen peroxide and thiourea dioxide. The use of this procedure can yield a high graft-reaction rate by a short-time treatment even under relatively mild conditions, thus this procedure is preferable.

An example of the graft reaction of the crosslinkable compound with a natural fiber by the use of the combination of hydrogen peroxide, a divalent iron salt and thiourea dioxide is illustrated in pages 17-20 of the specification.

The first advantage of the present invention is the easiness for incorporating the metal chelate-forming compound into the fiber molecule. In the present invention, the metal chelate-forming compound which is reactive to epoxy group and the

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crosslinkable compound which has glycidyl (epoxy) group are used respectively. This combination makes it easy to incorporate the metal chelate-forming compound into the fiber.

The second advantage of the present invention is the improved chelate-forming ability by bonding the metal chelate-forming compound to the fiber through the graft reaction product. Since the metal chelate-forming compound is bonded through the flexible grafted polymer (graft reaction product), the metal chelate-forming compound in the present invention can form metal chelate easier than the metal chelate-forming compound directly bonded to the fiber, due to the higher mobility. On the other hand, WO 98/16680 discloses the metal chelate-forming compound, for example polycarboxylic anhydride, is directly bonded to a fiber. Thus, the chelate-forming ability of the present invention is superior to that of the publication.

The third advantage of the present invention is that the metal chelate-forming compound can be introduced into the natural or regenerated fiber in a higher ratio (amount). In addition, in the present invention, the crosslinkable compound which has for graft polymerization. This system provides a glycidyl group in each unit of the crosslinkable compounds which constitute the

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graft polymer chain (see pages 17-19). Therefore, it is possible to increase reaction sites of the natural or regenerated fiber for metal chelate-forming compound and to introduce the metal chelate compound in a higher ratio. As a result, the chelate-forming ability will be enhanced.

Claims 1 and 15-18 recite "epoxy group is bonded to a fiber molecule of a natural fiber or regenerated fiber through a graft reaction product of a crosslinkable compound which has a reactive double bond and a glycidyl group in its molecule."

Claim 10 also recites "subjecting a crosslinkable compound having a reactive double bond and a glycidyl group in its molecule to graft reaction with a fiber molecule of a natural or regenerated fiber using a redox catalyst; and allowing the resulting graft reaction product to be bonded with at least one metal chelate-forming compound selected from the group consisting of aminodicarboxylic acids, thiocarboxylic acids and phosphoric acid which are reactive with an epoxy group." These features are not shown in the prior art of record.

WO 98/16680 (the publication) relates to a novel metal chelate forming fiber, a process for preparing the same and a method of metal ion sequestration using the fiber. The metal

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chelate forming fiber is capable of selectively adsorbing metal ions present in a slight amount in water such as copper, zinc, nickel and cobalt with a high efficiency even at low pH. The metal chelate forming fiber is usable in many applications including purification of waste water discharged from factories and purification of drinking water.

WO 98/16680 discloses that the metal chelate forming fiber contains an acyl group which contains nitrogen and a carboxylic acid. The acyl group is introduced into a reactive functional group. The functional group has reactivity with an anhydride of polycarboxylic acid.

WO 98/16680 also discloses that examples of fiber include various plant fibers, various animal fibers, various synthetic fibers and regenerated fibers.

WO 98/16680 also discloses that in some embodiments the fiber does not have any reactive functional group. In these cases, another reactive functional group is introduced into the molecule of the fiber by any method such as oxidization or graft polymerization for introducing the reactive functional group with an anhydride of polycarboxylic acid.

WO 98/16680 does not disclose epoxy group is bonded to a

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fiber molecule of a natural fiber or regenerated fiber through a graft reaction product of a crosslinkable compound which has a reactive double bond and a glycidyl group in its molecule.

WO 98/16680 also does not disclose subjecting a crosslinkable compound having a reactive double bond and a glycidyl group in its molecule to graft reaction with a fiber molecule of a natural or regenerated fiber using a redox catalyst; and allowing the resulting graft reaction product to be bonded with at least one metal chelate-forming compound selected from the group consisting of aminodicarboxylic acids, thiocarboxylic acids and phosphoric acid which are reactive with an epoxy group.

Applicants also note that the Examiner pointed out "the publication teaches a metal chelate forming fiber in which reactive functional groups are grafted onto a natural fiber or regenerated fiber" (see page 3, lines 3-4, in the office action). Applicants believe that it is not apparent whether or not the reactive function group can be introduced into the fiber efficiently in the publication. However, in the present invention the glycidyl group is disclosed as being possible to introduce into each repeating unit of the crosslinkable compounds

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which constitute the graft polymer chain. As a result, it is possible to increase the introduced amount of the metal chelate-forming compound, thereby enhancing the chelate-forming ability.

For these reasons, it is believed that the publication does not show or suggest the present claimed features of the present invention; therefore, this rejection should be withdrawn.

Claims 1-18 were rejected under 102(e) as being anticipated by Nambu et al. (U.S. Patent No. 6,168,863).

Applicants respectfully submit that U.S. Patent No. 6,168,863 does not qualify as a prior art reference under 35 USC 102(e), because the international filing date of this reference was filed before November 29, 2000 (see MPEP Section 2136.03 (II)(C)(1)). Applicants believe that the priority date of the present invention (February 26, 1999) is earlier than the effective filing date of this reference (October 22, 1999). Therefore, applicants believe that this rejection should be withdrawn.

Claims 1-18 were rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-11 of U.S. Patent No. 6,168,863 (U.S. Patent '863).



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The Examiner believed that the metal chelate forming fiber of the present invention would obviate the metal chelate fiber having an acyl group as claimed in U.S. Patent '863.

This rejection is respectfully traversed in view of the following remarks.

U.S. Patent '863 relates to a fiber having a capability of forming a metal chelate, a process for producing the same, a method for sequestering metal ions with the same and a filter to which a performance of removing impurities and metal ions in a fluid is imparted using the fiber as a filter material.

U.S. Patent '863 discloses that a reactive functional group in fiber molecule with an acid anhydride group has a reactive double bond and covalently bonding the reaction product to a metal chelate-forming compound.

U.S. Patent '863 does not disclose that epoxy group is bonded to a fiber molecule of a natural fiber or regenerated fiber through a graft reaction product of a crosslinkable compound which has a reactive double bond and a glycidyl group in its molecule.

U.S. Patent '863 also does not disclose that subjecting a crosslinkable compound having a reactive double bond and a

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glycidyl group in its molecule to graft reaction with a fiber molecule of a natural or regenerated fiber using a redox catalyst; and allowing the resulting graft reaction product to be bonded with at least one metal chelate-forming compound selected from the group consisting of aminodicarboxylic acids, thiocarboxylic acids and phosphoric acid which are reactive with an epoxy group.

Applicants believe that the present invention disclose the metal chelate-forming compound is bonded to the fiber molecule through the graft reaction product (flexible grafted polymer). However, U.S. Patent '863 discloses that the acyl group is covalently bonded to the fiber molecule. The present invention also discloses that the metal chelate compound is introduced into the fiber by the reaction between the metal chelate forming compound and the glycidyl group of the graft polymer in the present invention (see pages 17 to 19 in the present invention). However, U.S. Patent '863 discloses that the metal chelate compound is introduced by the reaction between the metal chelate compound and the reactive double bond (see column 7 to 10 in U.S. Patent '863).

For these reasons, it is believed that U.S. Patent No.

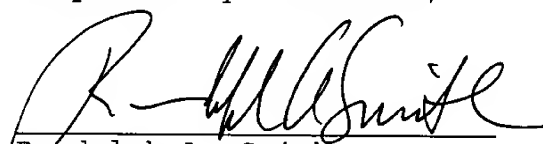
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6,168,863 does not show or suggest the present claimed features of the present invention; therefore, this rejection should be withdrawn.

In view of foregoing remarks, it is respectfully submitted that the application is now in condition for allowance and an action to this effect is respectfully requested.

If there are any questions or concerns regarding the amendments or these remarks, the Examiner is requested to telephone the undersigned at the telephone number listed below.

Respectfully submitted,

  
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